

HALL ET AL  
Serial No. 10/694,827  
Filed 10/29/2003  
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Group Art Unit 1754

Amendments to the Claims:

This listing of claims replaces all prior versions and listings of claims in the application:

Listing of Claims:

1. (Previously presented) A method of treating a gaseous medium including nitrogenous oxides to remove the nitrogenous oxides therefrom, which method comprises the operations of activating a gaseous hydrocarbon for achieving partial oxidation by generating an electric discharge in the gaseous hydrocarbon in the presence of a gas permeable first material which has oxidative properties in the presence of a non-thermal plasma and contacting a combination of the activated hydrocarbon and gaseous medium with a second material adapted in the presence of the activated hydrocarbon to catalyze the reduction of the nitrogenous oxides in the gaseous medium to nitrogen.

2. (Previously presented) A method according to claim 1, wherein the gaseous medium includes carbonaceous particulate material and the gaseous medium also is subjected to oxidation by the first material.

3. (Previously presented) A method according to claim 1, wherein the hydrocarbon is added to the gaseous medium.

4. (Currently Amended) A method according to claim 1, wherein the first and second materials are particulate and are intimately mixed and ~~that~~ the volume ratios of the first and second materials lie in the range twenty to eighty percent.

5. (Previously presented) A method according to claim 1, wherein the first and second materials are confined to separate regions of a reactor system and the gaseous medium

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and hydrocarbon are passed through the region containing the first material before the region containing the second material.

6. (Previously presented) A method according to claim 1, wherein the first material is barium or calcium titanate.

7. (Previously presented) A method according to claim 1, wherein the second material is selected from the group comprising the aluminas known as Alcoa LD-350, Catal Industrial CT-530, Condea hollow extrudates, T-60 Alumina, and Cordierite, or mixtures thereof.

8. (Previously presented) A method according to claim 1, wherein the second material is photo catalytic.

9. (Previously presented) A method according to claim 8, wherein the second material is titanium dioxide or cerium dioxide.

10. (Previously presented) A method according to claim 9, wherein the second material is a mixture of the anatase and textured rutile phases of titania.

11. (Currently Amended) A method of treating a gaseous medium including nitrogenous oxides to remove the nitrogenous oxides therefrom, which method comprises the operations of activating a gaseous hydrocarbon for achieving partial oxidation by generating an electric discharge in the gaseous hydrocarbon in the presence of a gas permeable first material which has oxidative properties in the presence of a non-thermal plasma and contacting a combination of the activated hydrocarbon and gaseous medium with a second material adapted in the presence of the activated hydrocarbon to catalyze the reduc-

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~~tion of the nitrogenous oxides in the gaseous medium to nitro-~~  
~~gen A method according to claim 1,~~ wherein the second material  
is a mixture of equal parts by weight of anatase phase titania  
and zirconia.

12. (Previously presented) A method according to claim  
1, wherein the second material is a metal-doped zeolite con-  
taining a material adapted to produce catalysis promoting  
cations.

13. (Previously presented) A method according to claim  
12, wherein the zeolite second material contains cerium or  
lanthanum.

14. (Previously presented) A method according to claim  
1, wherein the gaseous medium is the exhaust emissions from an  
internal combustion engine.

15. (Previously presented) A method according to claim  
14, wherein the hydrocarbon is provided by unburnt hydrocar-  
bons present in the exhaust emissions.

16. (Currently Amended) A reactor system for the plasma  
assisted treatment of a gaseous medium to remove nitrogenous  
oxides therefrom, which system comprises a gas permeable body  
including a first material adapted in the presence of a non-  
thermal plasma to activate, for partially oxidizing, a gaseous  
hydrocarbon passing therethrough, a gas permeable body includ-  
ing a second material adapted in the presence of an activated  
hydrocarbon ~~to catalyze~~ for catalyzing the reduction to nitro-  
gen of nitrogenous oxides contained in the gaseous medium and  
means for applying to the first material a potential suffi-  
cient to excite an electric discharge in a gaseous hydrocarbon  
passing through the said body including the first material.

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17. (Previously presented) A reactor system according to claim 16, wherein the first and second materials are particulate in form and are mixed together.

18. (Previously presented) A reactor system according to claim 17, wherein the ratio of the surface areas of the particles of the first and second materials lies in the range twenty to eighty percent.

19. (Previously presented) A reactor system according to claim 16, wherein the body of the first material is separate from the body of the second material and upstream thereof, and a combination of the gaseous medium from which nitrogenous oxides are to be removed and a hydrocarbon are passed through the body of the first material before being passed through the body of the second material.

20. (Previously presented) A reactor system according to claim 16, wherein there is provided a source of a gaseous hydrocarbon, a first reactor to which the source of hydrocarbon is connected, said first reactor containing a gas permeable bed of the first material and means for establishing an electric discharge in the gaseous hydrocarbon in the interstices in the bed of the first material, a second reactor including a gas permeable bed of the second material and means for combining plasma activated hydrocarbon from said first reactor with the gaseous medium from which nitrogenous oxides are to be removed prior to the combination passing into the said second reactor.

21. (Currently amended) A reactor system for the plasma assisted treatment of a gaseous medium to remove nitrogenous oxides therefrom, which system comprises a gas permeable body including a first material adapted in the presence of a non-

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thermal plasma to activate, for partially oxidizing, a gaseous hydrocarbon passing therethrough, a gas permeable body including a second material adapted in the presence of an activated hydrocarbon for catalyzing the reduction to nitrogen of nitrogenous oxides contained in the gaseous medium and means for applying to the first material a potential sufficient to excite an electric discharge in a gaseous hydrocarbon passing through the said body including the first material; a source of a gaseous hydrocarbon, a first reactor to which the source of hydrocarbon is connected, said first reactor containing a gas permeable bed of the first material and means for establishing an electric discharge in the gaseous hydrocarbon in the interstices in the bed of the first material, a second reactor including a gas permeable bed of the second material and means for combining plasma activated hydrocarbon from said first reactor with the gaseous medium from which nitrogenous oxides are to be removed prior to the combination passing into the said second reactor; A reactor system according to claim 20, wherein there is included a further reactor through which the gaseous medium from which nitrogenous oxides are to be removed is passed prior to the combination of the plasma activated hydrocarbons therewith, said further reactor also including a gas permeable bed of the first material and means for establishing an electrical discharge in the gaseous medium in the interstices of the bed of first material in said further reactor thereby to effect the oxidation of particulate carbonaceous material in the gaseous medium.

22. (Previously presented) A reactor system according to claim 16, wherein there is included means for establishing an electrical discharge in the gaseous medium within the interstices of the gas permeable body of the second material.

23. (Previously presented) A reactor system according to

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claim 16, wherein the first material is barium titanate or calcium titanate.

24. (Previously presented) A reactor system according to claim 16, wherein the second material is selected from the group comprising the aluminas known as Alco LD-350, Catal Industries CT-530, Condea hollow extrudates and Cordierite or mixtures thereof, metal doped zeolites further containing a material adapted to produce catalysis producing cations, mixtures of anatase and rutile phase titanias and photocatalytic metal oxides.

25. (Previously presented) A reactor system according to claim 24, wherein the second material is a metal-doped zeolite also containing cerium of lanthanum.

26. (Previously presented) A reactor system according to claim 24, wherein the second material is titanium dioxide or cerium dioxide.

27. (Currently Amended) A reactor system for the plasma assisted treatment of a gaseous medium to remove nitrogenous oxides therefrom, which system comprises a gas permeable body including a first material adapted in the presence of a non-thermal plasma to activate, for partially oxidizing a gaseous hydrocarbon passing therethrough, a gas permeable body including a second material adapted in the presence of an activated hydrocarbon for catalyzing the reduction to nitrogen of nitrogenous oxides contained in the gaseous medium and means for applying to the first material a potential sufficient to excite an electric discharge in a gaseous hydrocarbon passing through the said body including the first material; ~~A reactor system according to claim 16,~~ wherein the second material is a mixture of equal parts by volume of anatase phase titania and

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zirconia.

28. (Previously Presented) A reactor system for the plasma assisted treatment of a gaseous medium for removing nitrogenous oxides therefrom, which system comprises a gas permeable body including a first material adapted in the presence of a non-thermal plasma to activate oxidatively a gaseous hydrocarbon passing therethrough, a gas permeable body including a second material adapted in the presence of an oxidatively activated hydrocarbon to catalyze the reduction to nitrogen of nitrogenous oxides contained in the gaseous medium and means for applying to the first material a potential sufficient to excite an electric discharge in a gaseous hydrocarbon passing through the said body including the first material; wherein there is provided a source of a gaseous hydrocarbon, a first reactor to which the source of hydrocarbon is connected, said first reactor containing a gas permeable bed of the first material and means for establishing an electric discharge in the gaseous hydrocarbon in the interstices in the bed of the first material, a second reactor including a gas permeable bed of the second material and means for combining plasma activated hydrocarbon from said first reactor with the gaseous medium from which nitrogenous oxides are to be removed prior to the combination passing into the said second reactor; wherein there is included a further reactor through which the gaseous medium from which nitrogenous oxides are to be removed is passed prior to the combination of the plasma activated hydrocarbons therewith, said further reactor also including a gas permeable bed of the first material and means for establishing an electrical discharge in the gaseous medium in the interstices of the bed of first material in said further reactor thereby to effect the oxidation of particulate carbonaceous material in the gaseous medium.